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EXPERIMENTS WITH OSTRICHES.

VII.—TIME OF QUILLING.

By Professor J. E. Duerden, Rhodes University College, Grahamstown.

The time of the year at which to quill his ostriches is a matter of much concern to the farmer. In connection with it a number of considerations have to be taken into account, such as the age of the bird, its nutritive state, and the climatic conditions. The time selected may determine whether the succeeding crop of feathers will be the best the bird is capable of producing or one greatly inferior in value.

A.—The First Quilling.

There is no uncertainty as to the time at which the first quilling must take place if, as is always the case, it is desired to keep the later feather growth even. The wing plumes (spadonas) are always ready for clipping when the chicks are about six months old, and, under ordinary conditions, the quills left in the follicles or sockets are ripe two months later. The first quills are therefore drawn when the chicks are about eight months old. By this time the blood has practically receded from the quill, and the pith or medullary space is dry and occupied by air. When drawn at this stage the quills are usually not narrowed off at the base, but for a quarter of an inch or less the tip is still unhardened, and contains a little of the soft medulla, which is, however, practically bloodless. This is the stage which the farmer most desires to secure. If the quills are drawn earlier, say with half an inch still soft and containing blood, then the operation gives rise to hæmorrhage and, as a result of experience, it is found that the subsequent feather is not likely to be well grown; if the quills are left somewhat longer, say until the tip is narrowed and the pith altogether dried up, then the later growth does not commence so readily or uniformly, and some of the new feathers may be about to push out.

Should the artificial drawing of the first quills not take place at or about eight months then irregularities of feather growth are introduced which may lead to considerable trouble afterwards. It is found that the feather germs of some of the second or juvenal feathers commence active growth as soon as the chick quills are ripened, and then begin to push out the old spadona quills. Only certain of these germs, however, start their growth, others remain dormant for a long period, may be several months. Thus where artificial quilling is not practised irregularities are at once introduced, some juvenal feathers are growing while others are dormant. Should the farmer neglect to pull the spadona quills until the chicks are nine months old it will even then be found that the tip of some of the old quills has already a portion of the new feather attached to it, and this is torn away in the drawing of the quill. When this happens the later feather, having had its apical portion detached, is nearly always defective.

The biological fact is thus established that all the wing quills are ripe at practically the same time, that is, at about eight months; but the germs of the new feathers do not become simultaneously active so long as the quills remain in the follicles, some germs become active but others do not.

The growth of the new feather and the consequent pushing out of the old quill would correspond with the natural moult, and, in a state of nature, this never proceeds simultaneously for all the wing plumes, nor indeed for any of the series of feathers over the other parts of the body. In wild ostriches it is always found that only a few of the wing plumes are actually growing at one and the same time; the rest are old, over ripe feathers not yet moulted. The actual order according to which the 34 or more wing quills of the ostrich are naturally moulted has not yet been determined, but it is found that those at the free or distal end of the wing are the first to be shed, while they are closely followed by those towards the fixed extremity, the latest to drop out being the feathers along the middle of the wing. In experiments carried out to determine the quality of the feather growth resulting from the natural shedding of the quills it was found that odd feathers appeared here and there, the sequence on opposite wings not necessarily corresponding. The order of moulting of the wing quills has been somewhat fully investigated in homing pigeons, where the matter assumes a great significance in the racing powers of the birds. It has been ascertained that the feathers are moulted in a fairly definite sequence, and such would probably be found to be the case in the ostrich were a sufficient number of specimens available for such an experiment.

A second biological fact has been established which is of the greatest value in ostrich management. The removal of a quill, whether ripe or unripe, at once stimulates the germ below to activity, and the new feather begins to appear quite irrespective of any natural sequence. The germ would not become active were the quill not drawn, but does so when this takes place. Thus by artificially removing when ripe or nearly ripe all the old quills, a complete new crop of feathers is secured, which likewise all come to ripeness at about the same time. It is this fact which renders the farming of the ostrich so much more satisfactory than would be the case if the feather growth were dependent upon the irregularities of natural moulting. The farmer keeps his records and from them knows fairly accurately when he may expect a clipping of feathers and also when the quills should be drawn. The first feathers are ready for clipping at six months, and the stumps of these are ripe for drawing at eight months; the second crop of feathers is ripe six months later, that is, at fourteen months, and the quills of these can be drawn in two months, when the bird is a year and four months old or thereabouts.

As a matter of practice it is not always that one can secure the uniform growth of every member of a complete crop of feathers on both wings. Odd plumes are very liable to be trodden out in the herding of the birds, or to be drawn out by accident at any stage of their growth. In this case the new feather which replaces the lost one commences to grow at once, and is necessarily not at the same stage of growth as the others.*

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*It is an interesting fact that in young birds a feather growing out of the regular order corresponds in character neither with those of the crop before it nor the crop after it. It comes at an intermediate time and is intermediate both in its size and other features between the plumage before it and the plumage after it. In nature there are no sharply defined plumage stages in the ostriches; one plumage passes gradually into the other, and the new feathers appearing at any stage represent the stage of development reached by the bird at that time. Until the adult plumage is reached any odd new feather differs from those in advance of it and those coming after.

These odd feathers are very troublesome for they are rarely as perfect in their growth as the feathers growing simultaneously, and their clipping and quilling demand attention at different times from the others. If in the endeavour to secure evenness they are drawn while still far from ripeness, say at the same time as those naturally ripe, the next feather from the same socket is almost invariably greatly inferior. Some farmers, however, prefer to follow this course rather than admit irregularities in the crop. The feather following upon the inferior one is said to be the equal of the rest.

B.—The Second and Later Quillings.

All the "first-after-chick" or juvenal feathers are usually ripe at fourteen months, that is, six months after the quills of the spadonas have been drawn, and the plumes are always clipped at this period. The quills of these are then ripe in two months, when the bird is about sixteen months old, and can be extracted from the follicles. Compared with the first or spadona quills, it is, however, not necessary for the second or juvenal quills to be drawn immediately on attaining ripeness. It is found that none of the germs for the third crop are as forward in starting their new growth as was the case with those of the second crop. Indeed the germs may all remain dormant for several months beyond sixteen so long as the quills are left in position, and the remark applies to all the subsequent crops of quills.

The farmer has thus much more choice as to the time at which he can pull the second or juvenal quills than he had as regards the first or spadona quills, and other considerations now begin to determine which course he will follow.

The length of time during which all the germs for the third crop of feathers will remain dormant while the ripened quills are in position is found to vary with the nutritive condition of the bird and the climate. A bird in a high nutritive state will soon begin to push out some of the old quills and certain of the new feathers will appear, though they would remain quiescent in a bird in low condition. Along the coastal plain, with its mild winters and abundance of pasturage, it is found that the new growth cannot be kept back so readily as on the Karroo with its marked seasonal changes. Therefore the farmer, anxious to keep his feather growth even, has to take account of this and act accordingly. As a matter of fact the times of clipping and quilling the feathers of ostriches follow altogether different systems in the two areas. The two systems of quilling may be known as the *eight month system* and the *yearly system*.

1. *The Eight Month System.*—This system of quilling is largely followed on farms along the coast and for some distance inland, where the climatic changes between summer and winter are not great, and vegetation grows more or less freely throughout the year. Here at all stages of the ostrich it is found practically impossible to keep back the new growth once the quills are ripened and, rather than introduce irregularities, the quills are all drawn on attaining ripeness at about two months after clipping. For the second quilling this, as already shown, occurs when the birds are about sixteen months old. After these quills are drawn and all the new germs commence activity, and a third crop of feathers is ready for clipping by the time the ostrich is a year and ten months old, the quills of these being ripe when the bird is two years old. In this way a clipping of feathers, followed by a quilling, is secured every eight months, or three in two years, and this can be continued year after year.

The regularity of the eight month system can be maintained only under the most favourable conditions. The birds must be kept in a high state of nutrition practically all the time, such as is possible only with lucerne pasturage supplemented by other artificial feeding. Even under these conditions many farmers, for the reasons mentioned below, find it advantageous to allow the quills three months in which to fully ripen, thus introducing a *nine month system*.

It is of interest to ostrich farmers in South Africa to know that the eight month system is that followed on the ostrich farms in the United States and in New Zealand.

2. *The Yearly System*.—On the Karoo farms, where the elevation is 3,000 or 4,000 feet or more, the differences in temperature between summer and winter are considerable, and it is found that feather growth does not proceed so freely during the colder weather when food is not plentiful. Here it is possible to allow the stumps of the second or subsequent crops of feathers to remain in the sockets for as long as from four to six months without any of the new growth beginning to show itself. By doing this, however, only one crop of feathers is secured annually. This single crop is usually clipped about the commencement of the breeding season, which is generally in May or June, and the farmer endeavours to have the feathers of all his birds ripe about the same time.

C.—Comparison of the Eight Month and the Yearly Systems.

It is manifest that the financial proceeds from ostrich farming will differ greatly according as only one crop of feathers is obtained yearly or three crops in two years, as in the eight month system. As already shown, however, the system which is followed is not left wholly to the discretion of the farmer; he is largely obliged by the nature of the conditions to follow one or the other. It remains to be seen what is the influence upon the feather producing powers of the bird according as one system or the other is followed, for it can scarcely be expected that a bird will produce the same quality of feathers three times in two years as once each year. As a matter of experience the more observant farmers find that they are more likely to secure a better crop of feathers by clipping only once a year than by forcing the birds to produce a crop every eight months, and many would prefer to follow the first system were it practicable, that is, could the quills be kept back. Where an eight months' crop is regularly expected it is found that the feathers produced begin to deteriorate after four or five years; the forced production seems to partially exhaust the ostrich as regards quality of feather growth, and the best farmers find it necessary to get rid of their feather birds after this age. On the other hand a bird producing only one crop annually will continue to give feathers of the same quality for a very long period, cases being known where this continued from fifteen to twenty years. The difference of returns from superior feathers as compared with inferior is so great that to-day quality is a much more important consideration than quantity. Many matters, therefore, have to be taken into account by the farmer before deciding which system to adopt, where in certain intermediate districts both courses are possible. The factors discussed below have some bearing upon the question as to how far the quilling interval can be accelerated or retarded and thereby one system or another followed at choice.

D.—Condition of Bird and Quilling.

The domesticated ostrich is a much more sensitive creature than would be expected and varies greatly in its state of health, particularly during the first two years. This variation is dependent largely upon the quantity and quality of its food, its freedom or otherwise from parasites, and the nature of its surroundings. Experience has abundantly proved that its nutritive condition has a great influence upon the quality of the feather produced during the particular period. Many a crop of feathers is almost worthless or greatly depreciated in value as a result of the bird being in an enfeebled condition during the time of growth. Experience has further shown that the quality of the feather produced by any individual ostrich is largely dependent upon the condition of health of the bird at the time the new feather actually commences its growth, that is, at and shortly after quilling. It would seem that the character of the feather which will be produced is determined from its earliest stage, and is scarcely or not at all improved by any later improved condition of the bird. A bird which under good physiological conditions would produce a valuable feather may yield an inferior plume if in a weak condition at the commencement of the growth of the feather. Further, if a bird be quilled while in feeble health or suffering from insufficient food the new growth rarely appears evenly; some of the sockets will remain blank for a longer or a shorter period, and the feathers which ultimately appear will usually be smaller and more defective than would be expected. Very cold weather at the time of quilling is also likely to result in a number of blanks, and birds have been almost ruined by what seems to be a chilling of the exposed open socket.

The influence of the nutritive condition on the young growth is now so well recognised that few farmers quill their birds at a time when they are reduced from drought or other troubles. To do this would be disastrous to the new crop. In this lowered physiological state it is found that if the quills are not drawn the new growth will remain in abeyance and thus the farmer can delay the operation until more favourable times. Often during a prolonged drought the quills are allowed to remain for months beyond their natural period of ripeness, to be drawn when the veld again becomes green. Were the quills to be drawn during the drought the new crop would be much inferior in character. Also birds afflicted with wire-worm rapidly become enfeebled, and were the quills to be drawn before recovery the subsequent feathers would probably be defective.

So important is it for the birds to be in a healthy vigorous condition when the new growth commences after quilling that many ostrich farmers now follow the plan of allowing the birds to become somewhat reduced for one or two months previous to clipping, and then to put them under the most favourable circumstances, say from a week or two before quilling. It is difficult under highly artificial conditions to keep an ostrich in its best condition for a prolonged period, hence it is advisable to concentrate one's efforts in this direction to the most critical time of the new feather growth. Feathers are much more likely to show bars during the early period of their growth, and if they can be given a good start for three or four months they will probably go along successfully for the rest of the six months.

When the feathers are growing normally it is found that a reduction of the nutritive state, from whatever cause, will in extreme cases result in a total suspension of the feather development. The partly grown feather comes to an end, there is an interval without barbs and barbules, and then upon the restoration of better conditions the growth is renewed. The new growth, however, represents an entirely new feather, not a completion of the original feather.

We may thus conclude that it is of the highest importance for the best feather production that a farmer should quill his birds only when the latter are in a highly nourished condition owing to an abundant supply of food, and that he should maintain them in this state for at least three or four months afterwards. The early stages are the most critical in the history of the feather.

E.—The Natural Time for Quilling.

In the management of his birds the ostrich farmer is more likely to be successful the more nearly he can adapt his methods to the natural tendencies of the bird. The production of feathers under farming conditions is at best a highly artificial process for such a roving bird as the ostrich, and natural tendencies should be followed wherever possible. To a certain degree the feathers of a bird bear a relation to its sexual condition. Among all birds it is found that the plumage is at its highest degree of development at the commencement of the mating season. The feathers of gaudily coloured birds are the brightest and most perfect at this time, and are usually considered to be of some advantage in enabling the cock bird to attract his mate. Moulting in nature must therefore take place at such a period as will enable the new feathers to reach their highest perfection with the advent of the mating season.

The mating season for the ostrich in most districts of Cape Colony commences in the months of April, May, and June. It is at these times that the adult cock under natural conditions shows his most perfect plumage, the scutellations of his limbs and his beak are then at their brightest crimson, and the whole activity of the bird shows him to be full of vigour and energy. If, therefore, the time of quilling can be so arranged that the new crop of feathers will come to ripeness during these mating months the farmer can reasonably expect that the plumes will be the best the bird can produce. As a feather crop requires six months to ripen from the date of quilling it is obvious that the best months for the operation are the three last months of the year. During these and the first two or three months of the succeeding year the sexual instincts are less pronounced and the bird is more likely to be in a physiological state suitable for the production of the best feather growth.

By this method of quilling the feather commences and attains a good proportion of its growth during the summer months of the year, October to April, which in the Eastern Province happens to be the time when the rainfall is heaviest and the veld is in the best condition.

Many ostrich farmers, especially in the higher parts of the Colony where the contrasts between summer and winter are greatest, already follow the method here given, without, however, any appreciation of the fact that it is correlated with the natural sexual tendencies of the bird. They quill towards the end of the year and the feathers are ready for clipping towards the middle of the next year. It is also worthy of note that in practically all districts the months of June and July are considered to be the most unfavourable for quilling, that is, for the starting of a new feather crop, and these are the months during which the sexual instincts of the ostrich are highly developed.

The natural method of quilling can be easily adopted where the yearly system of feather growing is followed, but is necessarily not possible under the eight month system. It is well that ostrich farmers should bear the principle in mind and as far as possible direct their operations in conformity with it.

F.—Quilling of Tail and Covert Feathers.

The account given above applies more especially to the single row of feathers, variously known as remiges or wing quills, or technically as "wings," and as "whites" in the cock and "feminas" in the hen. These are by far the largest and most valuable of the ostrich plumes, and call for the chief consideration, though the two rows of wing coverts above them and the tail feathers are always taken and realise good prices. The wing coverts in the cock are technically known as "blacks" and in the hen as "drabs," while the tail quills or rectrices are known as "tails." The tail and covert feathers together are known as "short stuff" or "shorts."

Farming practice varies much as regards the taking of the tails and coverts. Sometimes they are not clipped at all, but allowed to remain until their quills are fully ripe when the entire feather is drawn. This is especially the case with chicks, where the shorts are worth but little. Plucking,* of course, saves the trouble of two separate operations instead of one, clipping being omitted. Against this it is found that the feather undergoes some deterioration if, instead of being clipped when the vane or flue only is ripe it is allowed to remain on the bird until the quill also is fully mature. The feather is undoubtedly at its best and richest immediately the flue is fully open, and most farmers now clip both the tails and coverts, at any rate of their most valuable feather birds, and the stumps are drawn later.

The tails and coverts come to ripeness in advance of the remiges, their quills being matured about the time the latter are ready for clipping. Hence the tails and coverts can be drawn at the time the wings are clipped, another two months being allowed for the quills of the latter to ripen; or, once established, the tails and coverts can be clipped a couple of months in advance of the clipping of the wings and their stumps drawn at the time the wings are clipped.

In any case it is advisable that the quills of the coverts (blacks or drabs) and of the wings should not be drawn simultaneously. The coverts should be drawn at least two months in advance of the wings, then the former are showing two or three inches beyond the socket and are beginning to open at the time the quills of the wings are drawn. As a result of their advanced growth the coverts are able to protect from exposure the follicles of the remiges and the new feathers as they appear, and this protection seems to have considerable influence on the new growth.

Another consideration is worthy of mention in support of the practice of getting the coverts well started on their growth before the new wing feathers begin. It is a well-known principle in the physiology of animals that under ordinary conditions the amount of the nutritive blood distributed to any organ is in proportion to the needs of the organ. Much more blood is distributed to a growing feather than to one with its quill nearly or altogether ripened. Therefore when the two rows of coverts are in an active growing state a stronger stream of blood is passing to the wing than if they were all dormant. As a result of this more blood is already available for the new germs of the wing feathers on their awakening to active growth as a result of the removal of the quill. Also the greater the supply of blood which is passing to the entire wing the more likely is the supply to be regular and constant, and thus each growing feather receives its due proportion. From this point of view the growth of any feather is more likely to be regular and uniform the greater the number of the other growing feathers which are around it. Hence the advantage of the simultaneous growth of all the feathers on the wing, both remiges and coverts alike. It has already been stated as a fact of everyday experience that odd feathers growing alone are rarely ever as perfect as those growing in the crop; the blood supply to them seems diminished and irregular.

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*It may be noted that in ostrich farming the terms "plucking," "clipping" and "quilling" are used in a technical sense: *Plucking* for the drawing of the feather as a whole; *clipping* for the removal of the plume portion of the feather along with a short portion of the quill; and *quilling* for the drawing of the quill or stump only.

G.—The Advantages of Simultaneous Quilling.

The drawing of the quills of the ostrich feather by the farmer really implies subjecting the bird to an artificial moult in advance of its natural time. It is performing what Nature herself would accomplish, though in a much more leisurely manner. The life of a feather is as follows:—In all birds a new feather, nourished by a rich supply of blood, first appears beyond the follicle; it increases in length and the flue opens out, and ultimately it attains its full size. The quill within the socket then ripens and, the feather as a whole being fully formed, the nutritive blood stream is withdrawn from the medulla. The mature feather remains on the body for a time, often becoming faded, old and worn, and is ultimately pushed out or moulted by the growth of a new feather below it. The length of time during which a fully grown feather will remain on the bird without moulting varies greatly, being largely dependent upon the situation of the feather and the nutritive state of the bird.

In the ostrich there is no well-defined season of moult. At no time are more than a few feathers being pushed out by the new growth, and the passage from one well-defined plumage to another, as from the chick to the juvenal, or from the juvenal to the adult, is very gradual, and takes place in different birds at different ages. It is this irregular continuous moulting which renders it practically impossible to farm ostriches by relying upon the natural moult alone. The commercial feathers on any bird would be at very different stages of growth and need separate attention, while the quantity of feathers produced would be much smaller owing to the length of time which in nature a ripe quill will remain within its socket.

The advantages, therefore, of artificially pulling all the quills at one time are that all the commercial feathers are growing at the same stage, and consequently all come to ripeness together and so facilitate farming methods; also many more feathers are being produced at the same period, thereby giving a heavier and more remunerative yield. In addition experience proves that when the feathers are all growing together they are more symmetrical in shape from their mutual protection, and are much less likely to be defective.

A comparison may be instituted between the feathers of a wild ostrich subject only to the natural moult and those of the domesticated bird with its artificial moult. Feathers are occasionally obtained from wild birds which are longer and stronger than any produced by the domesticated ostrich, but as a rule they are much inferior and are almost as liable to have barring defects. Any superiority in the feathers of wild birds is not of such a character as to encourage the farmer to adopt the natural method of moulting. There appears to be a decided advantage as regards shape and freedom from defects in having all the feathers growing simultaneously, and, as I have shown, this may be physiologically understood by the fuller and more uniform stream of nutritive blood which is produced from the greater drain upon it. Probably all are prepared to admit that there has been a vast improvement in the feather of the domesticated bird compared with that of the wild bird, due largely to artificial selection in breeding, and it is not unlikely that there is an unconscious selection going on in the direction of birds which produce their best feathers when growing them simultaneously.

Where carefully performed the drawing of a ripe quill is not injurious to the bird and apparently not to the socket nor to the subsequent new feather. If performed too frequently, so as to unnaturally force the feather growth, the feathers are found to deteriorate in quality. Experiments are being conducted as to the best remedies for treating the opened and injured sockets, so as to assist their healing after the operation and, if possible, insure that the new growth shall begin well.

SUMMARY.

1. The best time of the year at which to quill ostriches involves considerations as to the age of the bird, its nutritive state, and the climatic conditions.

2. The first quilling must be carried out when the chicks are about eight months old, otherwise irregularities will be introduced by the uneven growth of the new second crop, some feathers of which can not be kept back by allowing the quills to remain in their follicle.

3. The extraction of a quill at once stimulates the growth of a new feather, quite irrespective of any natural order of appearance of the feather, and thus evenness of growth can be secured by simultaneous quilling.

4. The second quilling may take place at about sixteen months, at which time the quills are ripe; but under certain conditions the operation can be delayed for several months longer.

5. The quills of the second and later quillings may be left for many months within the socket, even after they are ripe, provided the birds are not in a high nutritive condition; otherwise some feathers of the new crop will appear and thus introduce irregularities.

6. Eight month and twelve month systems of quilling are very largely practised according to climatic conditions, though both systems admit of considerable variations.

7. The continuous practice of the eight month system in time results in a deterioration of the feather produced, whereas this does not follow from the yearly system.

8. The nutritive condition of the bird at the time of quilling has a great influence upon the quality of the next crop of feathers, and, where possible, birds should be quilled only when in a highly nourished state.

9. The natural time for quilling seems to be during the last months of the year, so as to bring the plumes to ripeness about the beginning of the mating season.

10. The quilling of the tail and covert feathers (black or drabs) should take place about two months in advance of that of the wings, so that the new growth may serve as a protection to the latter and also induce a rich supply of blood to the wing as a whole.

11. The advantages of simultaneous quilling are that all the commercial feathers are at the same stage of growth, and hence facilitate farming methods; also the yield is heavier and the feathers are more likely to be of better shape and freer from barring and other defects.

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